SINGLE LINK HINGE ASSEMBLY WITH BREAK-AWAY LINK

Background of the Invention

U.S. Patent No. 6,453,510, the disclosure of which is hereby expressly incorporated by reference herein, describes a single link hinge assembly. FIGURES 1-4 of the present application illustrate such a single link hinge assembly **10** as described in the 6,453,510 patent. The hinge assembly **10** includes an elongated channel member **12** preferably defined from a U-shaped member that defines a longitudinally extending recess **14** in a front face. The channel member extends axially between first and second opposite ends **16,18**.

A claw member **20** is pivotally connected to the channel **12** adjacent the first end **16** at a pivot point **22** by way of a transverse rivet or other fastener **24**. Thus, the channel **12** is adapted for pivoting movement relative to the claw **20** about the pivot point **22** on an arc **E** in respective first and second opposite directions **E1,E2**. The channel is movable on the arc **E** to and between a first operative position (FIGS. 1-3) and a second operative position (FIG. 4). As is generally known in the art, the claw **20** is adapted for connection to an appliance frame or chassis, such as that of an oven or the like, and the channel is adapted for connection to an appliance door, such as an oven door. Thus, the hinge assembly **10** (typically provided in a pair) is adapted for supporting an appliance door relative to the appliance frame so that the door is pivotally movable between a closed position that corresponds to the first operative position of the channel **12**, and an open position that corresponds to the second operative position of the channel **12**. The transverse rivet **24**, or a sleeve,

bushing, roller or other member **24'** (FIG. 3) held thereby in recess **14**, provides a link stop **40a**, the purpose of which is described in full detail below.

In addition to being interconnected at the pivot point **22**, the claw and channel **12** are operably interconnected by a link assembly **30** comprising a single link member **32** and a spring **34**. A first end **32a** of the link member **32** is pivotally connected to a central region of the claw **20** by a rivet **36**, and a second end **32b** of the link member **32** is connected to a first end **34a** of the spring **34**. The second end **34b** of the spring is fixedly secured to the channel member **12**, preferably adjacent the channel member second end **18** or at least at a point axially spaced from the first end **16** of the channel member **12**. As shown herein, spring **34** is a coil spring conformed with hooks at both its first and second ends **34a,34b** -- the hook at the spring first end **34a** adapted to engage an aperture **38** or other portion of the link member **32**, and the hook at the spring second end **34b** adapted to engage a projecting portion **19** of the channel second end **18**. The link member **32** also defines opposite first and second contact surfaces or edges **42a,42b**, respectively.

The hinge assembly **10** further comprises a link control member **40b**, preferably provided in the form of a sleeve or roller **25'** (FIG. 3) supported on a rivet or other fastener **25** and spanning the recess **14** adjacent the second contact surface **42b** of the link member **32**. The link member **32** is located between the link stop **40a** and the link control member **40b**.

As shown in FIG, 1, a first end of the second link

contact surface **42b** defines a projecting lobe **44** that is conformed to engage the link control member **40b** when the channel **12** is moved to its first operative position. The lobe **44** urges the link control member **40b** and, thus, the channel member **12**, away from the link member **32** to hold the channel member **12** in its first operative position. The second end **46** of the second contact surface **42b** is conformed to curve smoothly toward the channel member **12**. Notably, for reasons described below, no dwell point need be defined in the second end **46** of the surface **42b**. This allows the link member **32** to be smaller in size

The spring **34** is preferably a coil spring that normally biases the channel **12** into its first operative position. When the channel is in its first operative position, the spring **34** is relatively but not completely relaxed. Upon movement of the channel **12** in the first direction **E1** on the arc **E** toward the second operative position, the spring **34** elongates and is tensioned. As the spring elongates, the link **32** moves toward the first end **16** of the channel **12**, with the link control member **40b** preferably continuously engaging the second contact surface **42b** of the link **32** as this movement occurs.

With particular reference to FIGURE 4, when the channel **12** is moved fully into its second operative position, the link control member **40b** is engaged with the second end **46** of the second link contact surface **42b** which causes the link **32** to be urged away from the channel **12**, i.e., outwardly of the channel recess **14**. The first contact surface **42a** of the link **32** engages and is held in engagement with the link stop **40a**.

Those of ordinary skill in the art will recognize that, owing to the fact that the first and second contact surfaces **42a,42b** of the link member **32** are in respective contact with link stop **40a** and link control member **40b** when the channel member **12** is in its second operative position, the channel member **12** is unable to pivot farther in the first direction **E1**, i.e., engagement of the first and second link contact surfaces **42a,42b** with the stop **40a** and control member **40b**, respectively, provides a stop that defines the second operative position of the channel member **12**.

When the channel **12** is in its second operative position as shown in FIGURE 4, the link **32** is wedged into engagement with the link stop **40a** and link control member **40b**, and is also held in position by the fastener **36** that connects the link **32** to the claw **20**. With the link **32** so positioned, application of force on the channel member **12** in an effort to move it further in the first direction **E1** beyond the second operative position causes the force to be distributed in a triangular pattern between the link stop **40a,** the link control member **40b,** and the connection point **36**. When the channel **12** is in its second operative position, the link **32** is engaged with and supported by the link stop **40a,** the control member **40b**, and the rivet or other fastener **36**.

Double link hinge assemblies including various break-away link structures are known and comprise multiple aligned links 32 for added strength. These are more expensive to manufacture as compared to single link hinge assemblies. For this and other reasons, it has been deemed desirable to

provide a single-link hinge assembly, such as the hinge assembly **10**, with a self-contained "over-open" or break-away mechanism (i.e., one not relying upon external components) that allow the channel member **12** to pivot relative to the claw in the first direction **E1** beyond the second operative position described above to a break-away position upon application of sufficient break-away force to the channel member 12 or an appliance door connected thereto for preventing damage to the appliance frame and/or the hinge assembly and to prevent tipping of the appliance.

Summary of the Invention

In accordance with a first aspect of the invention, a hinge assembly comprises a claw and a channel pivotally connected to the claw at a first pivot point and adapted for movement on an arc in a first direction and in a second direction opposite the first direction. The channel is movable from a first operative position in the first direction to a second operative position, and further in the first direction to a break-away position. A link control member is connected to the channel. A spring has first and second ends, and the second end is operably engaged with the channel. A single link member defines first and second opposite contact surfaces and first and second opposite ends. The first end is pivotally connected to the claw and said second end operably engaged with the first end of the spring. The second contact surface of the link member abuts the link control member and defines: (i) a peak; (ii) an operative surface portion on a first side of the peak that cooperates with the peak to define

a first dwell point; and, (iii) a break-away surface portion on a second side of the peak. The link member is movable relative to the link control member in response to pivoting movement of the channel relative to the claw. The link control member is in contact with the operative surface portion of the link when the channel is located in the first operative position; the link control member is located in the first dwell point when the channel is located in the second operative position; and, the link control member is in contact with the break-away surface portion of the link when the channel is located in the break-away position.

In accordance with another aspect of the present invention, an oven comprises a frame, a door, and at least one hinge assembly that movably connects the door to the frame. The at least one hinge assembly comprises a claw connected to the frame, and a channel connected to the door. The channel is also pivotally connected to the claw at a first pivot point and is adapted for movement on an arc in a first direction and in a second direction opposite the first direction. The channel is movable from a first operative position in the first direction to a second operative position, and further in the first direction to a break-away position, wherein: (i) the first operative position corresponds to a fully closed position of the door relative to the frame; (ii) the second operative position corresponds to a fully open operative position of the door relative to the frame; and, (iii) the break-away position corresponds to a non-operative over-open position of the door relative to the frame where the door is non-horizontal. A link control member is connected to the channel. A spring has first and second ends, and the second

end operably engaged with the channel. A single link member defines first and second opposite contact surfaces and first and second opposite ends. The first end is pivotally connected to the claw and the second end is operably engaged with the first end of spring. The second contact surface of the link member abuts the link control member and defines: (i) a peak; (ii) an operative surface portion on a first side of the peak that cooperates with the peak to define a first dwell point; and, (iii) a break-away surface portion on a second side of the peak. The link member is movable relative to the link control member in response to pivoting movement of the channel relative to the claw. The link control member is in contact with the operative surface portion of the link when the channel is located in the first operative position; the link control member is located in the first dwell point when the channel is located in the second operative position; and, (iii) the link control member is in contact with the break-away surface portion of the link when the channel is located in the break-away position.

In accordance with a further aspect of the invention, a hinge assembly for connecting an appliance door to an appliance frame is disclosed. The hinge assembly includes a claw and a channel pivotally connected to the claw. A single link member is pivotally connected to the claw, and the link member defines first and second contact surfaces. The second contact surface defines an operative portion and a break-away portion separated from the operative portion by a peak that projects outwardly from the second contact surface. A spring is operably engaged between the link member and the channel. A link control member is connected to the channel and contacts

the second contact surface of the link member. The channel is movable from a first operative position in a first direction on arc of 90 degrees or less to a second operative position where said link control member is in contact with the operative portion of the second contact surface of the link. The channel is movable from the second operative position further in the first direction to a break-away position that is more than 90 degrees from said first operative position where the link control member is in contact with the break-away portion of the second contact surface of the link.

Brief Description of the Drawings

The invention comprises a variety of components and arrangements of components, preferred embodiments of which are illustrated in the accompanying drawings that form a part hereof and wherein:

FIGURE 1 (prior art) is a side elevational view of a single-link hinge assembly in a first operative position;

FIGURE 2 (prior art) is a bottom view of the hinge assembly shown in FIGURE 1;

FIGURE 3 (prior art) is a front elevational view of the hinge assembly shown in FIGURE 1 as taken along view line 3-3;

FIGURE 4 (prior art) is a side elevational view of the hinge assembly shown in FIGURE 1 in a second operative position;

FIGURES 5 is a side elevational view of a break away hinge assembly with break-away link formed in accordance with the present invention in a first operative position;

FIGURE 5A is an enlarged side elevational view of the break-away link portion of the hinge assembly shown in FIG. 5;

FIGS. 5B-5D are side elevational views of the hinge assembly of FIG. 5 (without showing the spring) in broil, second and break-away operative positions, respectively;

FIGURE 6 illustrates a single link hinge assembly with break-away link formed in accordance with an alternative embodiment of the present invention;

FIGURE 6A is an enlarged side elevational view of the break-away link portion of the hinge assembly shown in FIG. 6;

FIGURE 7 illustrates a single link hinge assembly with break-away link formed in accordance with another alternative embodiment of the present invention; and,

FIGURE 7A is an enlarged side elevational view of the break-away link portion of the hinge assembly shown in FIG. 7.

Detailed Description of the Preferred Embodiment

FIGURES 5 shows a hinge assembly **110** formed in accordance with the present invention operatively connected a frame or chassis **O** of an oven or other appliance. More particularly, the hinge assembly **110** comprises an elongated channel member **112** preferably defined from a U-shaped member that defines a longitudinally extending recess **114** in a front face. The channel member **112** extends axially between first and second opposite ends **116,118**.

A claw member **120** is pivotally connected to the channel **112** adjacent the first end **116** at a pivot point **122** by way of a transverse rivet or other fastener **124**, and the fastener **124** supports a coaxial sleeve, bushing, roller or the like **124'** that at least partially transversely spans the recess **114** of channel **112**. In this way, the channel **112** is adapted for

pivoting movement relative to the claw **120** about the pivot point **122** on an arc **E** in respective first and second opposite directions **E1,E2**.

The channel **112** is movable on the arc **E** to and between a first operative position as shown in FIG. 5 and a second operative position shown in FIG. 5C. As is generally known in the art, the claw **120** is adapted for connection to an appliance frame or chassis **O**, such as that of an oven or the like, and the channel **112** is adapted for connection to an appliance door **D** (FIG. 5), such as an oven door. The hinge assembly **110** (typically provided in a pair) is adapted for supporting an appliance door **D** relative to the appliance chassis **O** so that the door is pivotally movable between a closed position that corresponds to the first operative position of the channel **112** (FIG. 5), and an open position (for access to a cooking chamber or other space) that corresponds to the second operative position of the channel **112** (FIG. 5C). The transverse rivet **124**, in combination with the sleeve **124'**, preferably defines a link stop **140a**, the purpose of which is described in full detail below.

In addition to being interconnected at the pivot point **122** by fastener **124**, the claw **120** and channel **112** are operably interconnected by a link assembly **130** that comprises a single link member **132** and a spring **134**. A first end **132a** of the link member **132** is pivotally connected to a central region of the claw **120** by a rivet or other fastener **136**, and a second end **132b** of the link member **132** is connected to a first end **134a** of the spring **134**. The second end **134b** of the spring is

fixedly secured to the channel member **112**, preferably adjacent the channel member second end **118** (or at least at a point axially spaced from the channel first end **116**). As shown herein, it is most preferred that, in order to minimize the use of fasteners such as rivets, the spring **134** be a coil spring conformed with hooks at both its first and second ends **134a,134b**; the hook at the first end **134a** is adapted to engage an aperture **138** or other portion of the link member **132**, and the hook at the second end **134b** is adapted to engage a portion **119** of the channel second end **118** or a structure connected thereto. The link member **132** also defines opposite first and second contact surfaces or edges **142a,142b**, respectively.

The hinge assembly **110** further comprises a link control member **140b** connected to the channel **112** and located in recess **114**. The link control member **140b** is preferably defined by a rivet or other fastener **125** connected to the channel **112** and spanning recess **114**, and including a sleeve, bushing, roller or the like **125'** coaxially supported thereon and extending transversely at least partially across recess **114**. The link control member **140b** is spaced axially from the link stop **140a** and is located adjacent the second contact surface **142b** of the link member **132**. As such, the link member **132** is located between the stop **140a** and the control member **140b**, with the first link contact surface **142a** oriented toward the stop **140a** and the second link contact surface **142b** oriented toward the control member **140b**.

The second link contact surface **142b** defines a projecting lobe **144** that is conformed to engage link control member **140b**

when the channel **112** is in its first operative position. The lobe **144** urges the link control member **140b** and, thus, the channel member **112**, away from the link member **132** so as to hold the channel member **112** in its first operative position with greater "pull-in" force. The lobe **144** also cooperates with the link control member **140b** so that the channel member **112** (including a door **D** connected thereto) counter-balances in an intermediate "broil-stop" position as shown in FIG. 5B when channel member **112** is moved manually to this position on the arc **E**.

With reference also to FIG. 5A where the link **132** is shown by itself, the second link contact surface **142b** preferably also comprises a cusp or peak **147** projecting outwardly therefrom that divides the second contact surface **142b** into an operative portion **142b-1** and a break-away portion **142b-2**. A first dwell point **146a** is defined at the intersection of the peak **147** and the operative surface portion **142b-1** and is preferably defined by a radiused surface that is dimensioned to mate with the link control member **140b**. The first dwell point **146a** is adapted to receive and retain the link control member **140b** therein when the channel **112** is pivoted to its second operative position as shown in FIG. 5C. In the embodiment illustrated in FIGS. 5 and 5A-5D, the break-away surface portion **142b-2** cooperates with peak **147** to define a second dwell point **146b** that comprises a cylindrical recess dimensioned to receive link control member **140b** when break-away surface portion **142b-2** moves adjacent link control member **140b** (FIG. 5C).

The spring **134** is preferably a coil spring that normally biases the channel **112** into its first operative position (FIG. 5). When the channel **112** is located in its first operative position, the spring **134** is relatively shortened and partially relaxed. Upon movement of the channel **112** in the first direction **E1** on the arc **E** toward the second operative position (FIG. 5C), the spring **134** elongates and is tensioned as the claw **120** pulls the link **132** downward toward channel first end **116**. As the link **132** moves toward the first end **116** of the channel **112** against the biasing force of the spring, the second contact surface **142b** of the link **132** rides on link control member **140b** which preferably comprises a roller to facilitate this action.

With particular reference to FIGURE 5C, when the channel **112** is moved fully into its second operative position, the link control member **140b** seats in the first dwell point **146a.** Under normal/intended operation, the channel **112** is never pivoted in the first direction **E1** beyond the second operative position as shown in FIG. 5C, and the weight of door **D** in combination with the shape of link **132** and its relationship with link control member **140b** and spring **134** ensures that the channel **112** and door **D** counter-balance in the second operative position. Peak **147** ensures that link **132** is resistant to further movement toward channel first end **116** relative to link control member **140b** that would cause peak **147** to move past link control member **140b** so that break-away surface portion **142b-2** contacts the link control member **140b**. If, however, sufficient excessive break-away force is applied to channel

112 (or door **D** to which it is connected) in the direction **E1** such as, e.g., a person placing his/her full or partial weight on the door **D**, link **132** will move further toward channel first end **116** relative to link control member **140b** so that peak **147** of link **132** moves past link control member **140b** and so that the channel **112** is allowed to pivot further in the first direction **E1** to a break-away or "over-open" position (FIG. 5D) (spring **134** elongates further to accommodate the movement). In this break-away position as shown in FIG. 5D, the link control member **140b** seats in second dwell point **146b**. The exact angle of the channel member **112** relative to the appliance chassis **O** in the break-away position can vary, but it is deemed desirable to define the break-away position such that the door **D** connected to the channel member **112** is sloped (moved past horizontal) to a position where a child or other unsafe load (e.g., a turkey) slides off of the door **D**.

When the channel member **112** is located in the second operative position, an angle **A** (FIG. 5C) of no more the 90 degrees is defined between the channel member **112** and a vertical portion of the appliance frame **O** to which the hinge assembly **110** is connected, i.e., the channel member **112** does not move past horizontal. As shown in FIG. 5D, however, in break-away position, the channel member 112 has moved beyond a horizontal state so that it defines an angle **A** with the vertical member of the appliance frame **O** that is greater than 90 degrees. Stated another way, the channel **112** moves no more than 90 degrees from its first operative position to its second operative position, and is moved more than 90 degrees

from its first operative position to the break-away (over-open) position. By allowing the channel member **112** to pivot beyond the second operative position (FIG. 5C) to the break-away position as described, damage to the hinge assembly **110** or appliance chassis or frame **O** is prevented, and tipping of the appliance is also prevented. The first contact surface **142a** of link **132** abuts link stop **140a** when the channel **112** is pivoted to the break-away position as shown in FIG. 5D. This abutment of first link contact surface **142a** with stop **140a** prevents pivoting movement of channel **112** in the first direction **E1** beyond the break-away position and also prevents movement of link **132** outwardly of recess **114**. Also, when first link contact surface **142a** engages stop **140a**, the stop supports link **132** and prevents deformation of same and/or damage to the link control member **140b.**

In the illustrated embodiment, once the channel **112** moves into the break-away position as shown in FIG. 5D, the force of spring **134** alone is insufficient to overcome the weight of the door and engagement of the link control member **140b** with second dwell point **146b** so as to return the channel **112** and link **132** to the second operative position. Instead, the hinge assembly **110** must be manually re-set by application of force to channel **112** (or door **D** to which channel is connected) in the second direction **E2** opposite the first direction so that link **132** will move away from first channel end **116**, with peak **147** moving over link control member **140b**, so that the link control member **140b** is once again moved into the first dwell point **146a** or further onto the operative surface portion **142b-**

1. Whether or not the hinge assembly **110** must be manually re-set after the channel **112** is moved into the break-away position can be controlled by the shape of the link **132** as described below. In certain applications, it has been deemed desirable to shape the link **132** such that an end-user can never manually re-set the hinge assembly **110** and must call a service technician. This can be accomplished by forming the link **132** so that, once the link control member **140b** moves over the peak **147**, simple application of force on the channel member **112** in the opposite direction **E2** is not sufficient to accomplish the re-set operation. This can be accomplished by forming the peak **147** with an undercut or the like.

The select force required to move the channel **112** from the second operative position to the break-away position can vary depending upon the force of spring **134** and the profile of the link **132**.

The link **132** can be formed alternatively as described below in relation to FIGS. 6, 6A, 7 and 7A. Except as otherwise shown and/or described, the hinge assembly **210** shown in FIG. 6 is identical to the hinge assembly **110** described above (spring **234** is shown on partially for clarity). As such, like components of the hinge assembly **210** relative to the hinge assembly **110** are identified with like reference numbers that are one-hundred greater than those used in relation to the hinge assembly **110**. The only difference between the hinge assembly **210** and the hinge assembly **110** is that the hinge assembly **210** comprises and alternative link member **232**.

The alternative link member **232** is shown separately in FIG. 6A. There, it can be seen that the break-away surface portion **242b-2** is flat and blends into peak **247** so that peak **247** and break-away surface portion **242b-2** cooperate to define the second dwell point **246b**. The presence of peak **247** that extends outwardly from and separates first and second dwell points **246a,246b** still requires that the hinge assembly **210** be manually re-set (as described above in relation to the hinge assembly **110**) after the link **232** moves into the break-away position where link control member **240b** seats in the second dwell point **246b** (FIG. 6). The re-set operation is performed by manually moving channel **212** via door **D** pivotally in the second direction **E2** opposite the first direction **E1**. As shown in FIGURE 6, the channel member **212** is unable to pivot in the first direction **E1** beyond the break-away position owing to the abutment of the first link contact surface **242a** with the stop **240a** while the link control member **240b** is seated in the second dwell point **246b**.

Referring now to FIGS. 7 and 7A, another alternative hinge assembly **310** is shown. Here, again, except as otherwise shown and/or described, the hinge assembly **310** is identical to the hinge assembly **110** described above (spring 334 is shown only partially for clarity). As such, like components of the hinge assembly **310** relative to the hinge assembly **110** are identified with like reference numbers that are two-hundred greater than those used in relation to the hinge assembly **110**. The only difference between the hinge assembly **310** and the hinge assembly **110** is that the hinge assembly **310** comprises

and alternative link member **332**. The link member **332** is shown separately in FIG. 7A. There, it can be seen that the break-away surface portion **342b-2** is flat and blends directly into the first dwell point **346a**, i.e., the break-away surface **342b-2** is flat and defines one face of peak **347**. As such, when the hinge assembly **310** is manipulated into the break-away position as shown in FIG. 7, the link control member **340b** lies in contact with the flat break-away surface **342b-2**. Upon removal or lessening of the break-away force being applied to channel **312** or door **D** connected to channel **312**, the spring **334** urges channel **312** in the second direction **E2** until link **332** moves relative to link control member **340b** away from the channel first end **316** sufficiently for the link control member **340b** to seat in first dwell point **346a** defined at the intersection of operative surface **342b-1** with peak **347**. Hinge assembly **310** automatically re-sets under biasing force of spring **334** from the break-away position to the second operative position upon reduction or removal of the break-away force that caused the hinge assembly **310** to move into the break-away position.

As noted, it is preferred that the link member **132,232,332** abut link stop **140a,240a,340a** when the channel member **112,212,312** is moved into the break-away position as shown in FIGS. 5D, 6 and 7, respectively, to prevent further pivoting of channel member **112,212,312** in first direction **E1**. This structure is also important in that it allows the single link member **132,232,332** to resist deformation when the channel **112,212,312** is moved into the break-away position, i.e., a group of two or more link members **132,232,332** is not required

for added strength and thickness of links **132,232,332** can be reduced. When the channel **112,212,312** is moved fully to the break-away position, the link **132,232,332** is wedged between the stop **140a,240a,340a** and link control member **140b,240b,340b.** The link **132,232,332** is also held in position by the rivet or other fastener **136,236,336** that connects the link to the claw **120,220,320.** As such, application of force on the channel member **112,212,312** in an effort to move it further in the first direction **E1** beyond the break-away position causes this force to be distributed in a triangular pattern between the stop **140a,240a,340a**, link control member **140b,240b,340b**, and claw connection fastener **136,236,336.**

The invention has been described with reference to preferred embodiments. Of course, modifications and alterations will occur to others upon a reading and understanding of the preceding specification. It is intended that the invention be construed as including all such modifications and alterations.